

THE MODEL ENGINEER

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The MODEL ENGINEER

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18TH MARCH 1948



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S M O K E R I N G S

Our Cover Picture

● MANY MODEL engineers take a delight in studying and modelling the windmill in its various forms; therefore, our photograph this week is certain to please. The picture is from a photograph by Mr. C. R. L. Coles, and it gives a most pleasing view of the fine post-mill on Reigate Heath, Surrey.

A Comprehensive Tyneside Programme

● GOOD NEWS comes to hand from Mr. E. de L. Lamb the publicity officer of the Tyneside Society. He writes:—"In my letter of January 13th I gave some particulars of the exhibition held by this society and as you were good enough to publish extracts from these, I am hoping that you will be interested to hear that the exhibition has had one sequel that is most encouraging. At a recent meeting of the Parks Committee a recommendation was made to the City Council that a piece of ground in one of the public parks be enclosed and placed at the disposal of the society for the construction of a locomotive running track about 650 ft. long, a lake for speed boats and a track for racing cars. The City Engineer's Department have been most helpful in suggestions for laying out the land, and the society is now busy with plans and estimates for constructing the multi-gauge track. The scheme as a whole will be, of course, a long-term

project; but, with the hearty co-operation of all members, that is expected. I hope that before the end of the summer (if any) I shall be able to report considerable progress." I am very pleased to hear of the co-operation being extended to the model engineers of Tyneside by the local authorities. This will result in a most attractive layout which will not only keep the Tyneside members busy for some time to come, but will, when completed, add very much to the entertainment and instruction of the local public both young and old.

The Model Car Association

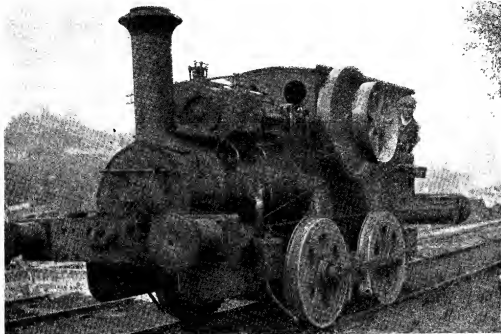
● THE INAUGURAL meeting has been convened for 2 p.m. on Friday, April 2nd, at Kingsway Hall, Kingsway, London, W.C.2. All who are interested are invited. Written nominations for the offices of Chairman, Vice Chairman, Secretary, Treasurer, P.R.O. and committee, bearing the name and address of the nominee, the office for which he is nominated and the name and address of the proposer, should be addressed to Mr. P. Denman, 23, Great Queen Street, London, W.C.2, to arrive not later than first post on Tuesday, March 30th. Further nominations will be accepted at the meeting, provided the nominee is present in the hall or a signed statement from the nominee is produced to the effect that he is prepared to stand for election.

An Aveling & Porter Locomotive

● THE PHOTOGRAPH reproduced on this page shows a rather quaint sort of locomotive, and was sent in by Mr. E. Kilner Berry who discovered the engine at work; he writes:—"The photograph shows a haulage engine employed at Messrs Pepper's lime quarries at Houghron Bridge, Amberley, Sussex, which I understand is the only survivor of three similar locomotives

"Frost Spike"

● IN PRE-WAR days we published an excellent series of articles on traction-engine details by a contributor who wrote under the signature of "Frost Spike." We have had several enquiries from readers who would like to see this series resumed. We have unfortunately lost the address of this contributor, but if he is still available we should be glad to hear from him again.



An old haulage locomotive at Amberley, in Sussex

made by Aveling & Porter of Rochester, about 1898, and which is still in service. I regret I cannot give any details of this quaint contraption, but would point out that what appears to be a connecting-rod is actually a tie-rod between the centres of the wheels, and serves to take the opposing thrust of the brakes which are between the wheels. Much of the construction appears to be similar to the familiar 'Invicta' rollers which were commonly seen some years ago, many of which, of course, are still on the roads." Other photographs of locomotives of this kind have appeared in THE MODEL ENGINEER from time to time. Certainly, the type is now very rarely found, though, at one time, it was quite commonly seen at large factories. Mr. J. N. Maskelyne recalls that, when he was an apprentice at Vickers' Works, Erith, in 1912, three or four of these engines were in use there. At present, there is one at Slough Gasworks, and can often be seen from either the road or the railway which pass close by. Perhaps the best-known of all these curious-looking old engines is the one which worked for many years on the Brill Tramway before that interesting line was taken over by the Metropolitan Railway.

A Swiss "Lone Hand"

● AMONG THE many replies to our Kelerendum, we have received one from a reader in Lausanne, Switzerland. He does not give his name or full address but describes himself not merely as a "lone hand" but as a "lost lone hand." Much as we sympathise with all "lone hands," a lost lone hand makes a special appeal to our consideration, and if our correspondent will disclose his identity we shall be pleased to help him in any way possible. We hope to hear from him.

A New Zealand S.O.S.

● FROM MR. R. LONGTON, 14, Queen Street, Feilding, New Zealand, comes a request for correspondence with club members or other "lone hands" like himself. He is particularly interested in anything relating to home-made lathes.

Percival Mackay

A Chiming Door Bell

by A. R. Turpin

"MRS. BROWN has got one of those door bells that goes ding-dong." That was all my wife said, but by the way she said it I knew I should have to do something, and, if I wanted those steaming cups of tea to continue to arrive in my workshop at the usual frequent intervals, I should have to do it quickly. I also knew it would be no good just supplying a bell that went ding-dong; at the very least, it would have to do ding-dong-dell. So my model of an atomic-powered scooter went on to the shelf. But life is like that, and out came the drawing board.

A number of ideas suggested themselves for making that super bell work, but it was eventually decided to build it on the same principle as a chiming clock, with a low voltage electric motor to supply the power. The caller presses the push-button and around go the works.

Unfortunately it was not quite as simple as that, because the average person only presses the button for about a quarter of a second, and you can't play much of a tune in that length of time. Only the most bombastic butcher's-boy is likely to exceed one second push duration. A relay would, therefore, be required, but the only cause for thought was to make it as reliable and simple as possible. The design soon sorted itself out, and resulted in the bell shown in Fig. 1, with the following specification:

Front door bell. Operated by 12 volts A.C. Will play any tune of 12 beats and four notes. Tune can be changed in five minutes. Button need only be pressed for $\frac{1}{4}$ sec.

Back door bell. Operated by 12 volts A.C. Gives peal on four bells. Operates only whilst button is pressed.

Operation of Front Door Bell

Drive is by a small electric motor: actually a D.C. motor was used. This will heat up if run continuously on A.C. supply, but as these motors will normally be used for only a few seconds at a time, this is not important. The efficiency will also suffer, but they may be over-run if necessary to increase the power. The author mentions this point because D.C. motors seem to be in better supply than A.C. at most of the surplus stores.

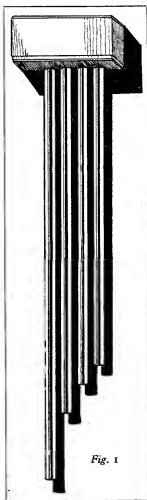


Fig. 1

This motor drives a shaft by a train of gears to give a speed of about 20 r.p.m. Mounted on this shaft "A" (Fig. 2), are four brass sleeves "B", which are fixed in position by grub-screws. Equally spaced round these sleeves are twelve 6-B.A. tapped holes, and into certain of these holes are screwed short lengths of steel rod "D", to form spokes (no doubt there is a correct technical term for these in the clock industry, but the author is no horological expert)!

As these spokes revolve they strike extensions on the bell hammers "E", causing them to lift, and as the spokes revolve further the hammers are released and fall by gravity and the force of a light spring "F", to strike the bells "G".

Mounted on the same shaft as the four sleeves is a fifth and larger sleeve "H", on the periphery of which is a vee-shaped piece of insulation. Immediately behind this sleeve is a pillar of ebonite "J", on top of which is mounted a spring contact-arm which, when in the stopped position, rests on the insulation vee-piece.

Now referring to the wiring diagram, it will be seen that when the bell-push is operated the motor will revolve the shaft, and the piece of insulation on the sleeve "H" will move from under the contact arm, and as this sleeve is connected electrically, via the shaft and bearings, to the frame; the bell-push will be shorted and the motor will continue to revolve when the bell-push is released, until the insulation-piece is again under the contact arm. The piece of insulation is made vee-shaped because the inertia will continue to revolve the shaft after the current has been cut off; and, by swinging the contact-arm across the sleeve, a position may be found where it comes to rest almost on the edge of the insulation and a very short push on the bell will restart it. Some latitude should be allowed, otherwise, on a warm day, the thinning of the oil may free the bearings sufficiently for the inertia to pass the insulation-piece right under the contact-arm, and the bell will continue to ring indefinitely.

The neighbours might complain if this happened when the family was out for the day.

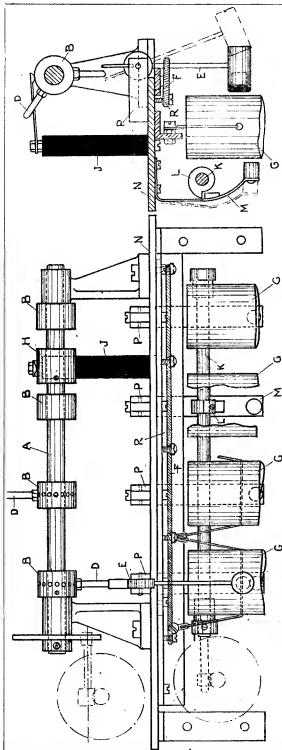
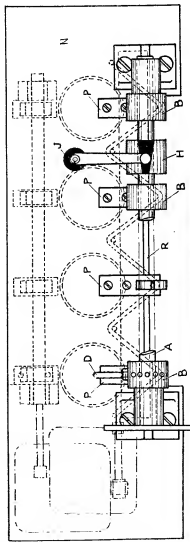


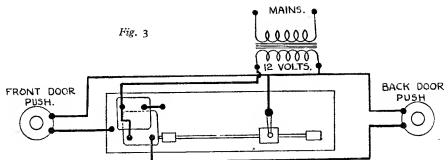
Fig. 2



Operation of the Back Door Bell

On the bell-button being operated, the second electric motor revolves a shaft "K" through a train of gears at about 120 r.p.m. Mounted on this shaft and fixed by grub-screws are four snail-shaped cams "L" which, as they rotate, flex four pieces of clock-spring "M," mounted below the base-plate.

with the bell are four short lengths of $\frac{3}{8}$ -in. brass rod "P," which are slotted in the front to support the bell hammers. These hammers consist of a disc of $\frac{1}{2}$ -in. brass, drilled in the centre to take a 16-s.w.g. wire spindle. A flat brass finger is silver-soldered in a slot in the top, and a 2 in. length of 16-s.w.g. piano wire



As the cams clear the wedge-shaped blocks, sweated to these springs, they flex forward, and the brass hammers riveted to the bottom ends strike the bells. As the cams are mounted 90 deg. out of phase, a peal rings out. The bells will continue to peal as long as the button is pressed.

Construction

No dimensions have been given on the drawing, as the exact design will, no doubt, depend on what is available in the junk-box. In the writer's case, most of the gears and motors came from aircraft camera components purchased from surplus stores. Duplicated parts have also been omitted in some cases for clarity.

silver-soldered in a hole drilled in the bottom. The actual hammer-head is fixed to this wire in the same manner, and the end is recessed to take a cap of wood, fibre or leather, depending on the mellowness desired. So that the bell will have a sharp clear note, the hammer is held just clear of the bell by a strip of brass "R," running along the front edge of the base-plate, and is fixed so that it may be adjusted for position by two 4-B.A. screws working in slots at either end of this bar. A weak coil-spring "F," or rubber bands threaded round five 6-B.A. screws projecting from the base-plate and round the stems of the bell hammers give them the necessary snap.

The bells themselves are lengths of 16-s.w.g.

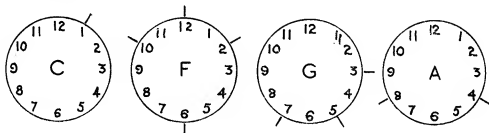


Fig. 4

The main base-plate "N" is of $\frac{1}{8}$ -in. brass, cut out in front to clear the bell hammers. A piece of brass angle $\frac{1}{2}$ in. \times $\frac{3}{8}$ in. \times $\frac{1}{8}$ in., "O" extends nearly the whole length of the base-plate and is secured by six 6-B.A. screws. This acts as a necessary stiffener and also is used to hang the bells on. Copper picture-wire is threaded through holes drilled in the bells soldered to tags, and fixed by 6-B.A. screws to this angle brass.

On top of the base-plate and mounted in line

seamless-drawn steel tube $1\frac{1}{2}$ -in. diam. The author uses the notes A, G, F, C, the length of which are: 42 in., 44 $\frac{1}{2}$ in., 47 $\frac{1}{2}$ in. and 55 $\frac{1}{2}$ in., respectively.

These may be painted or chromium plated, but the latter is expensive these days. Brass tube may be used, but the lengths will be different for the same notes.

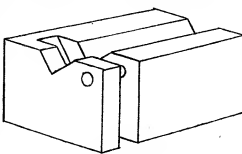
A step-down transformer will have to be constructed or bought; an ordinary bell

(Continued on next page)

A RETIRING V-BLOCK CLAMP

BEING faced with the difficulty of drilling small securing-pin holes across the diameter of small rods, the following V-block was designed to meet the case. The clamp sold with the usual V-block is a clumsy affair, and small drills are very short. If the rod to be drilled is also short, the chuck fouls the clamp.

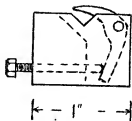
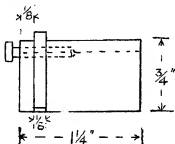
Investigations were undertaken in the work-



The prepared block

pin was provided with a head to facilitate removal if necessary. A vice jaw (also as sketch) was cut from mild-steel $\frac{1}{4}$ -in. plate, and case-hardened. A tapped hole $\frac{3}{32}$ in. was made through the block for the set-screw to butt against the tail of the vice jaw.

The grip of this clamp is surprisingly firm, even with the set-screw only finger tight, and in view



shop scrap-box, and a piece of cast-iron $1\frac{1}{2}$ in. \times 1 in. \times $\frac{1}{2}$ in. was discovered. This was squared up in the shaper and a V-groove cut down the centre lengthways. The block and groove were scraped as true as possible, and at $\frac{1}{2}$ in. from one end a slot $\frac{1}{2}$ in. wide was sawn, and filed to the shape shown in the sketch. A $\frac{3}{32}$ -in. hole was drilled as near the corner of the block as appeared advisable, and a plain pin was made. This

of this it would be an improvement to machine grooves in the sides of the V-block. These would enable the block to be used for light machining jobs. Also, while making one block, it would be better to use a double-length piece, cut in half after machining, and thus having a matched pair. This would more than double their value in machine work, if not in drilling.—W. V. KETHRO.

A Chiming Door Bell

(Continued from previous page)

transformer might work if a very small-power motor is used, but as most of the surplus types take an amp. or more, something bigger will be required.

Nothing is more annoying than to be continually answering the front-door bell, only to find an electrocuted corpse on the doorstep. So if you want to obviate this, see that the secondary of the transformer is well insulated. For preference, it should be wound on a separate paxolin former, and one side of the winding earthed. Do not rely on the insulation of the bell-push for safety; even the best insulation breaks down when wet with rain, so see that the secondary is well insulated. You have been warned!

The transformer need not be particularly efficient, except on "no load," and can, therefore, be kept quite small by using two gauges smaller than the size recommended for the continuous rating.

A cover will be needed to hide the mechanism, and can be of either plywood or metal. A simple method of fixing it is to cut a groove or fix a piece of brass channel on the ends of this cover, so the ends of the base-plate slides into them.

The easiest way to compose the tune to be used is to draw four circles on a sheet of paper, and number them like a clock face, ticking the number where a bell is required to be struck, and if the holes in the brass sleeve are numbered in a like manner, it is an easy matter to transfer the tune from the paper to the actual bell, by simply screwing the steel rods in the same holes in the sleeves. It should be pointed out that the same note cannot be hit twice following, without a beat in between, as the second rod will catch the hammer before it hits the bell, unless the lift is made very small. A couple of bars taken from the tune "T812" is shown in Fig. 4.

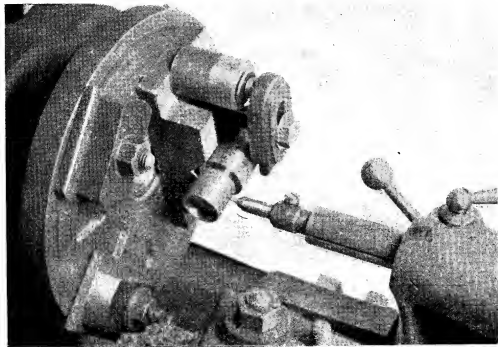
PETROL ENGINE TOPICS

*A 10-c.c. Flat Twin Two-Stroke Engine

by Edgar T. Westbury

PISTONS are designed to be machined from the solid, and again cast-iron is the most suitable material, hardened steel being a good second, but difficult to handle from the amateur constructor's point of view. A good deal of experiment has been made in methods of piston production, and it is possible that some new ideas may be described later on, but for the present, it has been found that the all-machined piston is the most

and reversing the motion of the pistons. Light weight of the latter is therefore just as important as in a single-cylinder engine if high speed is to be attained without excessive internal stresses, the essential difference being that in a well-designed flat twin, the *external* effect of the unbalanced forces in causing vibration of the engine structure is not apparent. In some respects, the removal of the symptoms of excessive



Boring the gudgeon-pin hole in piston, while still attached to chucking-piece. A Myford vee block is used for mounting work on the faceplate

practicable so far produced, and it can be made very low in weight if care is taken.

As this engine is at least partly dynamically balanced, the piston weights largely cancel out, and it might be thought that the only important thing is that they should be equal. It should, however, be remembered that the pistons are only interconnected through the crankshaft and the connecting-rods, so that unbalanced reciprocating forces are transmitted through these components and their bearings, which also bear the brunt of inertia forces entailed in stopping

reciprocating weight may be a bad thing, if it tends to make designers forget their existence; and this may perhaps explain why some flat twins in the past have been very prone to breakage of crankshafts and connecting-rods.

Some constructors seem to make heavy weather of machining pistons from the solid, though this is not a difficult or excessively delicate job if properly tackled; so it may be appropriate to give particulars of the methods which I have used with success. The pistons are made from round bar or "stick" material, the quality of cast-iron used for motor-car valve guides being highly suitable; each piston should have an ample allowance for a chucking-piece on it, and

*Continued from page 254, "M.E.," March 4, 1948.

this, if not already smooth and parallel, should be machined to a uniform diameter, in the case of a true pair as now under consideration.

Set up the bar truly in the chuck and carry out the main internal and external machining, leaving a small allowance for finishing on the outer diameter. The inside is bored to the diameter

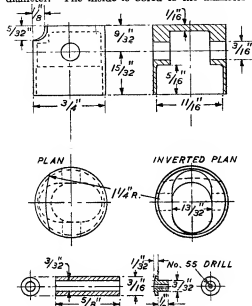


Fig. 8. Pistons (2 off, cast-iron) with gudgeon-pins (2 off, M.S., case-hardened) and end pads (4 off, brass)

between the bosses, or slightly under, and a flat drill or cutter used to finish the end of the hole; the skirt is then counterbored to finished diameter and depth. Before removing from the chuck, the bar may be necked down beyond the length of the piston, but ample strength should be left to support it for subsequent operations. Both pistons should be machined in this way before proceeding further.

It is now necessary to make a fixture to carry the chucking-piece on the cross-slide, with its axis parallel with the lathe axis and exactly at centre height. In some cases a vee packing strip in the tool-post will suffice, but a fair-sized vee block packed up to the correct height on the cross-slide is better; even more so, a "plummer block" type of fixture, bored in position from the chuck to the correct size for the chucking-piece. The important point is to carry the piston at centre height and axially true, also to secure it rigidly against cutting stress.

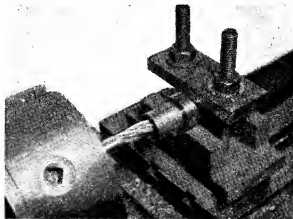
An end-mill is then run in the chuck and the elongated slot formed inside the piston. Although this entails blind working, since it is difficult to observe what is going on at the business-end of

the cutter, discreet use of the indices on the cross-slide and the saddle will enable the required shape and accuracy to be produced. If limit stops can be set up on the slides, so much the better. It will be noted that the slot is not cut to full depth on the deflector side of the piston, which calls for some care, but in this case also, measurement of slide travel will produce the desired result.

Boring the gudgeon pin holes may be carried out by mounting the component on a vee block attached to the faceplate of the lathe, so that its axis is parallel to the latter. Some constructors may prefer to drill these holes before milling the inside of the piston, and using a piece of $\frac{3}{16}$ -in. rod, inserted in the hole, to check the squareness of the latter when mounting the piston in the milling fixture.

I have always been very keen on being able to machine the crown of the piston on a two-stroke engine, so as to ensure accuracy and uniformity, as well as smoothness, but this is not always easy with the usual form of deflector, unless one makes a special milling fixture and possibly special cutters as well. In this case the sunk deflector can be quite easily machined by mounting the piston eccentrically, again calling on the services of our old friend the vee block attached to the faceplate, and setting the piston axially parallel to but approximately $1\frac{1}{4}$ in from the lathe axis. The corner of the deflector notch should have a radius of about $\frac{1}{8}$ in., a sharp internal corner being liable to cause eddying and flame trapping.

Finally the piston can be replaced in the chuck for finishing the external machining and lapping with a ring lap to the closest possible



Milling the inside of the piston, again using the Myford vee block for mounting the work on cross-slide

working fit in the cylinder liner; after which the piston may be parted off, completely finished without the need for any hand fitting or "fin-ailing" whatever.

The gudgeon pin calls for no special comment; it may be made of mild-steel (not silver-steel, as often recommended), to a tight fit in the piston, then case-hardened and polished. Soft pads of brass or aluminium are made to press into each end; the drilling of a centre hole will facilitate

fitting, as it will enable them to contract if slightly oversize, so long as a slight "lead" is given by tapering the ends.

The next component to be considered is the crankshaft, which is a most important working part in any type of engine, and demands correct methods and careful workmanship; but in the present case, more than ordinary care is necessary in both respects. It will be seen that the crankshaft is built up in three pieces, and the possibility of introducing serious errors in the complete

between the essential parts than is practicable with split big-end bearings. Moreover, the loosening of crankshaft attachments is less liable to result in a major breakdown, and if the ends of the shaft are well supported and steadied, it is even possible to run the engine with the parts practically "floating."

I trust that readers will agree that I have made out a fairly sound case for the use of a built-up crankshaft in this engine; but more than that, I am able to assure them that the form of design

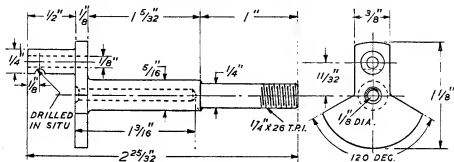


Fig. 9. Crankshaft main component (2 off, alloy steel)

assembly is fairly obvious; but the methods of machining which I shall describe, in conjunction with accurate workmanship, will completely eliminate these risks.

By many readers, the idea of a built-up crankshaft may be regarded as unsound, but I have adopted it in this engine, for several reasons; first and foremost, because it is, in my opinion, the lesser of two evils. One must necessarily choose between making the crankshaft capable of being taken apart, and using split big-end bearings in the connecting-rods. In a large engine it is possible to use a robust form of split bearing, not too clumsy in proportions and adequately bolted up; but this is by no means easy in a small engine, and in my experience, such bearings can, and often do, prove very troublesome. The loosening or breakage of a big-end bolt at high speed usually results in a major disaster, and in some cases, the complete "write-off" of the engine. Another reason why a split big-end bearing is undesirable in any two-stroke engine is that it takes up much more room than one of the solid type, so that extra clearance must be left in the crankcase and pumping efficiency is thereby lowered.

Although comparatively few model petrol engines have been made with built-up detachable crankshafts (as distinct from permanently fabricated shafts), this method of construction has been very successfully used in full-size practice, more particularly in single-cylinder engines, but also occasionally in engines having double- or multi-throw cranks. There have, it is true, been some examples of unsuccessful built-up crankshafts, but this has been due to errors in design or construction. While some forms of construction may not be easy to apply in a very small engine, it is generally possible to use stronger and more reliable means of attachment

adopted has proved quite satisfactory in practice. The engine illustrated in the photographs has undergone very severe mechanical tests, including not only running under considerable steady overload, but also wrenching of the ends of the shaft, without damage. But if any readers are not convinced, or if they shrink from what appears to be the formidable task of machining the parts to ensure accurate alignment, it is possible to use

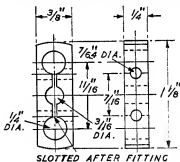


Fig. 10. Crankshaft centre web (1 off, alloy steel)

a crankshaft made from the solid, by adopting a modified form of connecting-rod, which will enable the latter to be assembled on the crankpin. I doubt, however, whether they will find the actual construction of a solid shaft any easier or quicker; neither is it to be assumed that such a shaft is immune from any risk of going out of truth under working stress.

The crankshaft assembly consists virtually of two complete one-piece overhung cranks (Fig. 9), with a centre web connecting the two crankpins (Continued on next page)

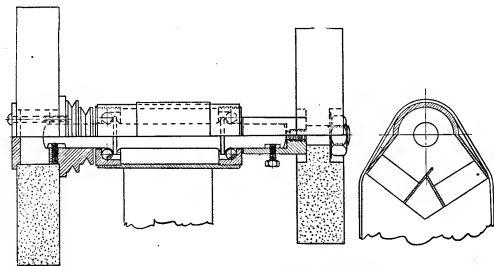
A Ball-Bearing Grinding Head

THE article by L. F. Bishop (MODEL ENGINEER, December 25th, 1947), bidding us draw inspiration from the scrap-heap, prompts me to describe a grinder evolved from a cycle bottom-bracket.

I was looking for the "makings" of a spindle to use two wheels I had by me, when I came across the bottom-bracket spindle, and decided

3/16-in. grub-screw, sunk below the face of the step, bears on the flat on the spindle. The wheel is fixed by a plate, held by three 4-B.A. screws, which just permit a 1-in. bore wheel being used.

I was somewhat doubtful of the behaviour of the cone-bearings at speed, so produced a two-step pulley. The small gives about 1,200 r.p.m., at which speed a high-frequency vibration starts,



to make use of this. I first contemplated softening the spindle, either drilling and tapping one end to take the stud carrying the smaller wheel (of 7/16-in. bore), or else reducing the spindle diameter, but doubted if I could re-harden the spindle to its previous state (it was made by B.S.A. some time before 1914, and shows no sign of wear!) The sleeve with grub-screw bearing on the flat where the cotter-pin fitted has so far proved satisfactory.

The larger wheel has a bore of about 1½ in., and fits on a step turned on the pulley. A

but using the larger pulley, at about 900 r.p.m. the wheels run very smoothly.

The whole is mounted on a block of oak, cut to fit round the two tube lugs, which are plugged with wood. The fork lugs are cut right away. It is held down by a steel strap bolted to the bench, back and front. The fittings are turned from duralumin, the pulleys being first bored, clamped to the spindle by the grub-screw, and the spindle then mounted between centres (it is already centre drilled), to turn the pulleys and step for the wheel.—M. E. PITCHER.

Petrol Engine Topics

(Continued from previous page)

(Fig. 10). It is obviously essential that the throw dimensions of the two crankpins should be identical, and that they should be exactly parallel with the main journals, to ensure true axial alignment of the latter when assembled. A further desirable, though not absolutely essential, feature is that the parts should be keyed or otherwise positively located to preserve alignment in the cross plane, once initially adjusted.

The two main components, which are illustrated in Fig. 9, may be produced by the methods which I have described for machining overhung crankshafts (see the issue of THE

MODEL ENGINEER dated March 21st, 1946). That is to say, the main journals are turned between centres and the crankpins machined by holding the journals in an eccentric turning fixture mounted on the lathe faceplate. The alternative method of turning the pins on offset throw centres, while sound enough for individual crankshafts, is not favourable to producing the necessary accuracy of throw dimensions which is so essential in this case, and would also introduce a further problem of ensuring accuracy in the machining of the centre web.

(To be continued)

*A Gauge "1" Electric Locomotive

by Victor B. Harrison

THE next thing to do was to see if anything could be done with the body. On the drawing-board I drew a line on the design $\frac{3}{8}$ -in. above the scale height of the roof on the drawing. I gazed at it a long time and finally came to the conclusion that no one except a super-expert would spot the difference in height. I, personally, felt much happier about it all. Also, there were many things to be done on the chassis before starting on the body. The first things were third-rail collecting shoes, which need not be described in detail as they are clearly seen in Photo 1. The most important problem now was how to reverse the motor, and on this the late Henry Greenly's book on electric locomotives again proved invaluable. I copied his design of a reversing and stop switch and was able to mount it alongside the motor with the operating arm projecting below the side frames; but as the loco had to be controlled by reversing the current in the track, the matter did not appear so very simple to me. I knew that to accomplish this the current must flow in the same direction, either in the field or the armature, and be reversed in either one or the other, not both.

Mr. Greenly, in his book, had got the diagrams and the full story of the MODEL ENGINEER "Twopenny Tube" loco built by the late R. A. Allman. In my youth, I saw this particular engine in action; in fact, I witnessed its birth and saw it many times during its construction. I was very young in those days so what I may have learnt then I had forgotten, but Mr. Greenly's description brought it all back to me. Mr. Allman's scheme was as follows:

He constructed a small permanent-magnet motor, and magnetised the field magnets himself. The armature was of H-section, to which suitable stops were attached, so that it could only rotate in an arc of 90 degrees, which was sufficient to work the rotary reversing-switch which was used to reverse the current in the armature of the two driving motors. Mr. Allman's motors were series motors wound for 12 volts. I have an idea that he could run them either in series or parallel by means of a special switch on the

loco. When current was switched on via the first stop on the starting resistance, the polarised reverser (otherwise the little permanent-magnet motor) set itself in the correct position according to the flow of the current. As the polarised reverser was wound to respond to a minimum of current, a cut-out had to be put in the circuit to prevent the delicate winding burning out

where the voltage increased. This cut-out worked on the second stud of the resistance and, at the same time, the loco began to move off in the required direction. It was most amusing to watch this engine start off; first, the click of the polarised reverser was heard, followed by the click of the cut-out and then the loco began

to move slowly off. It sounded just as if there were a driver on the engine and he was actuating the controller. To my mind, Mr. Allman's principle was the most satisfactory one.

The first job was to construct the polarised reverser. I was fortunate in being able to pick up a very small toy permanent-magnet motor. It was a shoddy little thing, except for the field magnet, but nobody could wish for better. I scrapped the original armature and commutator but retained the carbon brush-gear. I staggered this brush-gear and made a two-ring commutator. I had an "H" armature made at the works, out of an old $\frac{3}{8}$ -in. iron rivet. This was wound, at my suggestion, so as to work at 6 volts, which it did most definitely. I made a cylindrical reversing-switch, which was fixed to the armature shaft, with suitable brushes and terminals. The whole is mounted on a vulcanite base, and by good luck, it all fitted nicely on to the chassis without interfering with the drive from the motor. This reverser can be clearly seen in Photo 4.

The next item was the safety cut-out to protect the polarised reverser, and the result can be seen in Photo 7. I was fortunate enough to get two very small platinum points from the local garage proprietor, which were ideal for the job. All was now ready for wiring up; as the Allman motors were series-wound, I decided to connect my motor up as a series-wound one instead of shunt-wound.

I was most careful in following the wiring diagram in Mr. Greenly's book, but when I applied 6 volts to the running-rail and third-

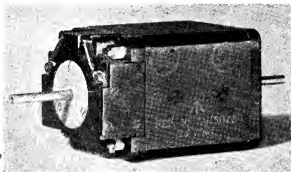


Photo No. 4. The motor

rail, all that happened was that the cut-out worked excellently. Neither the polarised reverser nor the motor showed any signs of life. It was most disappointing, but I consoled myself with the thought that perhaps it was only to be expected when a man is not an electrical expert. I showed it to my son when he came home on one of his periodical visits. All he did was to insert another wire from the cut-out to one of the pick-ups and, lo and behold, both

two connecting wires and insert one other. Keeping my fingers crossed, I switched on the 12 volts. There were two rapid clicks of the reverser and cut-out and the motor revolved and gathered speed. So far so good. I reversed the current and the motor revolved in the opposite direction. The reader can well imagine my delight, especially as I had solved the problem myself! My own theory as to why the motor would not run when connected up in series was

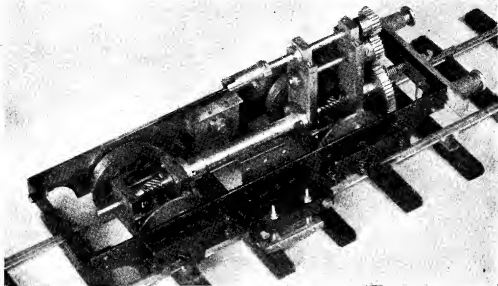


Photo No. 5. One of the bogies

cut-out and polarised reverser worked with the 6 volts. Although both seemed to work together, the reverser must have received a strong enough impulse to do its job before the cut-out came into action. I then tried 12 volts in order to get the motor to work. She did not show an inclination to revolve in either direction, even when disconnected from the drive.

I informed my works electrician of the trouble and his reply was that as I had altered the connection so as to make her into a series motor instead of a shunt motor, the field winding would not be passing sufficient current, and they would have to be rewound. At the same time, I had a reply from my son giving still more reasons why the motor would not run, but I must confess I could not quite take it all in. My son did suggest instead of rewinding, to rewire the connections, so as to reverse the motor as a shunt-wound. This gave me more food for thought. Greenly's book had nothing in it about reversing shunt-wound motors, nor had any of the other books that I had got; so I decided to see if I could solve the problem diagrammatically. After covering several sheets of paper, I discovered that I had solved the problem! I there and then got to work on the chassis and found that I had only got to discard

that, by connecting it up in that way, I had turned it into a 48-volt motor instead of it remaining a 24-volt motor.

I was now most anxious to have a try-out on the track, but the snow and the weather of February and the beginning of March prevented anything of that sort. There was about a foot of snow in the garden and, also, it would have been much too cold even if one had been able to get into the railway shed. I next tackled the pantograph retracting mechanism, which calls for no special comment as it is the same as on the Swiss loco and the S.R. train.

This was followed by the pantographs which, though not difficult, took time. Also, the collecting-shoe for releasing the pantographs was made. I was unable to fix this shoe to the underside of the bogies, so attached it to the floor of the chassis between the two bogies. I made it in the form of a long spring buffer, which allowed plenty of latitude when the centre rail was on a curve.

In April, it was possible to make some further tests on the track in the Central Station in the shed. On its own, the loco behaved perfectly; but the moment I attached a train, almost the full 30 volts had to be switched on. She then started off with a rush, and one had to be pretty

smart with the controller to avoid a derailment over the points.

I mentioned this to the works electrician, and he did not think the trouble could be got over unless the fields were rewound to carry more current; so I decided to let him do this. On the next test, the trouble of "rush" starting had completely vanished; the flywheels on the motor proved their usefulness when the collecting-shoes found gaps in the third-rail. The engine

morning. I realised the moment I saw it that the job was perfect, but he must have worked very hard to get it done in the time. In the meantime, the copper-depositing department were busy on another attempt. While all this was going on I had the fortune to meet Mr. Dow, the public relations officer of the L.N.E.R., on a special trip at the invitation of the S.R. to the Centenary Celebration of the Ashford locomotive works at Ashford in Kent. We were

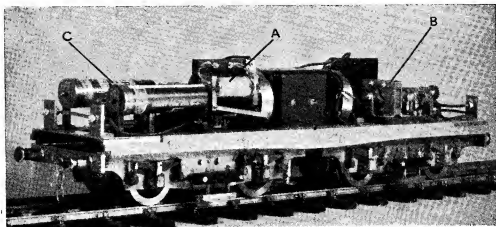


Photo No. 6. The chassis. A—Cut-in for lowering pantographs. B—Polarised reverser. C—Lighting batteries

never hesitated. Also, the flywheels make for smooth starting and gradual stopping.

Now for the construction of the body. I have no means in my workshop for bending sheet-metal, while in the engineering shop at the works they are well-fitted out in that respect. Our chief engineer there was most keen to get on with the job, and not only bent the body to shape to my design, but with the various bits and pieces that I had already constructed, completed it. The fitting of the pantograph retracting and locking gear gave us both a nightmare. After several discussions I reconstructed the gear and, at last, it fitted into the roof without interfering with the mass of mechanism on the chassis.

Then came the worst job of all, the making of the two driving cabs. It was found impossible to build them out of sheet stuff so I suggested that they should be shaped out of type metal and then copper deposited to the thickness of $\frac{1}{16}$ in. This was done, but the copper-depositing department must have done something radically wrong; not only was it very unevenly deposited, but the copper itself was very brittle indeed, the copper shell being absolutely useless. This was a bitter disappointment to me, since the works had once made some ventilators for my model ships in this way, and they were perfect.

Our chief engineer who never likes to be beaten, got some $\frac{1}{8}$ -in. thick brass-plate and, one week-end, he filed and milled out the actual ends and built up the sides with sheet-copper, presenting me with the finished job on a Monday

introduced in the dining-car on the way down by an old friend of mine, Mr. Grasemann of the S.R. I mentioned to Mr. Dow that I was building this model of the L.N.E.R.'s latest electric engines and he very kindly offered to send me some photos of it to show certain details I required. In due course, the photos arrived and they were just what I wanted. Also, Mr. Dow informed me that she is painted L.N.E.R. green, with black lining, edged with white. He was not sure of the roof but I thought it was dark grey. The lettering is in plain yellow with no shading.

To continue the description of the construction of the engine, the centre of the body is removable, leaving the two cabs attached to the chassis. Thus the mechanism on the chassis can be easily got at, and also the retracting and locking mechanism of the pantographs in the roof of the body, if any adjustment is required. The connections from the pantographs and the retracting mechanism, etc. are by four spring contacts, and so, no disconnecting of any wires need be done. Any testing of the driving mechanism can be tried out on the third-rail sections without the body being in place. On the chassis, two No. 8 dry batteries are accommodated for lighting the headlights either end. There should be four headlights, but I have only put in two at either end. Night running is not often indulged in, so when the midnight mail should be run the two headlights will look quite realistic.

On further tests with the loco attached to a train, more troubles made themselves apparent.

When going over the crossover on the south side of the Central Station the cut-out on the switch-board cut out. My son and I very carefully examined everything, but could find no traces of a possible short. The same thing happened when the loco left the third-rail section and the pantographs were released. I began to feel that we were up against an unsurmountable problem. It was most disheartening. One day, my son was demonstrating the engine to a friend and, when I got home, he reported that she was very inclined to slip when negotiating a rise. This, frankly, I could not understand at all. By chance, I discovered that the gear-wheel connected to the driving-shaft of the motor slipped on the shaft; so I pinned both of them and no longer relied on the grub screws.

On the next test on the track, there were no signs of slipping, but, on the other hand, the controller had to be pulled over nearly to full-speed before the loco would move. The ammeter also showed 6 amps instead of the usual 4. There was definitely something wrong. I could find nothing wrong in the connections, and all the electrical gadgets worked perfectly. I had followed Mr. Allman's principle most carefully, and so could not understand why my loco did not work. I therefore detached one of the bogies to examine it thoroughly and noticed that, at either end of the skew-gearbox the oil was very black, so came to the conclusion that the coupling shaft to the other box on the other axle was binding in the bearings.

On detaching that part of the bogie, the shaft ran perfectly easily; in fact, it was inclined to

whole thing rocked slightly and this action made the coupling-shaft jam in the end bearings. I quickly realised that the coupling-shaft to the other gearbox on the other axle was behaving in the same way as the cardan shaft on a car. The one gearbox, and probably the other one too, was trying to revolve round the wheel axles and therefore excessive pressure came on the bearing, hence the jamming. The first remedy that occurred to me was to bolt the two gear-boxes together by side-plates; but, if I did that, I would lose the articulation of the bogies. I finally hit upon the idea of fixing to one bogie a long casing, which reached nearly to the other box, and fitting to the other box a socket to receive the casing. This was not quite as easy as it sounds; the gearbox bearings, apparently, were not quite in line with each other. Nevertheless, it was finally achieved, and the whole reassembled, and the articulation had not been interfered with.

After this, when the bogie was pushed backwards and forwards by the top of the offending gearbox, there were no signs of binding and seizing. I then treated the other bogie in the same way as the first one, and had no further trouble from this cause.

I noticed, now, that the loco was much easier to push along the track by hand. On the next track test, there was a decided drop in the amperage on starting; but, even then, when going over the crossover and when arriving at the overhead portion out came the cut-out. I feel sure that if a sledge-hammer had been handy, that moment would have been the last

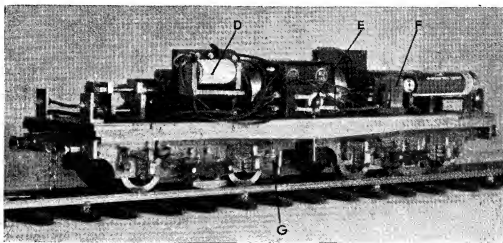


Photo No. 7. The chassis. D—Reverser cut-out. E—Hand reverser. F—Lighting switch. G—Pantograph release shoe

be sloppy. It was the same with the other gearbox. I re-assembled the whole bogie and, when pushed by the ends of the frames on its own, it ran perfectly easily. By mere chance I gave the bogie a push by the top of the gearbox on which the 6-to-1 gear wheels are mounted, and, to my astonishment, the wheels locked. By carefully watching things, I noticed that the

for the loco. Instead, I asked my son to try driving her. He managed, after two or three shots, to make her go over both the crossovers and release the pantographs at the overhead portion without the cut-out coming out. His diagnosis was that he had constructed the controller so that the first two studs were to be used

(Continued on next page)

A Simple Working Gas Turbine

ALTHOUGH I am usually associated with models of early mining machinery (and rightly so, for that is my chief interest), I have dabbled with gas turbines. It is only right that I point out that mine was a crude affair built of tin cans and old gas fittings, but it worked, over sixteen years ago.

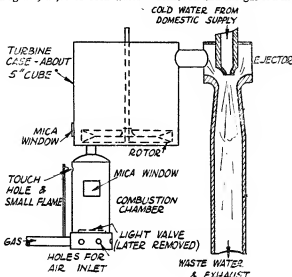
Referring to the diagram, a jet of cold water in the ejector drew a current of air and gas through the combustion chamber. Not having any electrical ignition gear, a small flame was drawn into a touch-hole at the side of the combustion chamber, so as to cause an explosion therein. After the hot gases had expanded into the turbine and the pressure had subsided, a fresh charge would be drawn in, and so on. A light disc-valve prevented the explosion blowing out of

the inlet holes. Admittedly a little was wasted at the touch hole.

Actually, nothing of the sort happened: combustion took place with a smooth quiet hissing noise. The mica window showed that the inside of the chamber was very much like a bunsen burner. The non-return valve was removed and the gas led in through a number of

small holes so as to mix it with the air better. The touch hole was plugged.

It might be suggested that the ejector was pulling the turbine round, but that was not so, for it would not move unless the combustion was taking place. As soon as the hot gases reached the ejector, there was a great increase in speed, and often the sides of the turbine case became concave due to the rapid contraction of the exhaust gas. — F. D. WOODALL.



A Gauge "1" Electric Locomotive

(Continued from previous page)

more for slowing down trains and locos than for starting up; and the next two for starting up and, therefore, the jump in current between the third and fourth was too great. Consequently, the break in the current came as the shoes left the third-rail at the crossover, and when they re-connected the sudden surge of current upset the cut-out. The same thing occurred when the release solenoid came into action when the overhead line was reached. My son is therefore going to construct a new controller with more contacts which he claims will eliminate these troubles.

We then coupled the loco up to my heavy continental train and made the first trip round the track. My son drove her and successfully negotiated the two sources of trouble. On the open road, the heavy train did not worry the loco at all; up-hill or down-dale made no difference to the speed. The acceleration was terrific from a standing start, and I am glad I was not a passenger in one of the coaches!

There is only one fault with the loco, and that is that the height of the body of the model is

$\frac{3}{8}$ -in. higher than it should be. This, in the original would be equivalent to 1 ft. Otherwise she is to scale. As I mentioned before, I had to raise the body in order to accommodate the pantograph retracting and release solenoids. If I had been an electrical expert, or my son had not been away at Cambridge, one might have managed to construct smaller solenoids and then she would have been to scale. But on my railway, I have American and German model locos and rolling stock, so I can excuse myself that, as the railway is international, all is, after all, in order. All my friends who heard that I was electrifying a portion of my line considered that I was making a retrograde step; and now they have seen the electrification, they thoroughly approve of it and say that the "Hurst Central" is absolutely up to date. This has cheered me up very much as I have my many friends to thank for their help and suggestions for the success and the appearance of my railway, which has made me very many charming friends all over the world.

Correcting a Bent Mandrel

by R.N.L.

WHEN last I burst into print (see *THE MODEL ENGINEER*, December, 4th, 1947), I described the making of a gauge for setting over the topslide of my lathe to turn Morse tapers, and this gauge having proved a quick and accurate aid to setting the topslide, I set out to do a job which had been crying out for attention ever since I bought the lathe some eighteen months ago. Due to some very obvious misuse while in a munitions factory, the mandrel of my lathe was slightly out-of-truth. New head-stock bearings, carefully scraped, had failed to rectify the fault, and the only remedy appeared to be the refitting of the chuck back-plates and re boring of the existing No. 2 Morse taper socket.

Skimming

The chuck back-plates were straightforward turning jobs and were accomplished in two evenings' work, and I hoped that the M.T. socket would only require very slight "skimming out" so that the existing centres would remain usable. Alas! I skimmed and skimmed, and the pile of wafer-like shavings grew and grew, and it was long ere the sound of an even and continuous cut gave evidence of "truth" at last. Withdrawing the tool with a sigh of relief I brushed out the hole with a nice round bristly brush on a long wire handle (sold as spout brushes for teapots), and gave a final polish with a clean rag on the end of a piece of stick. Then I tried the "live centre" to see how it would fit. It popped into the hole nicely, popped right out of sight, and its needle point winked knowingly from within the safety of the new and mighty cavern which I had bored so laboriously. It was a nice snug fit in its new recess, but its usefulness as a centre was not very practicable. So I began to think of turning up a special centre to fit my mandrel socket of No. 2-and-a-bit M.T. That would have been the easiest way out of my difficulty, but it would have brought in its train other problems, for it would have precluded the use of all fitments on standard arbors, and I possess quite a few such accessories, including a set of collet adaptors.

One from the Old School

My problem was solved for me by an old friend, a very old man who has grown grey in the Clydeside engineering world, and who served his apprenticeship in the hard school of the treadle-lathe and hammer and chisel. He it was who supplied me with a Morse taper drill adaptor, No. 2 M.T. inside, and No. 3 outside, and who suggested that I turn it down on the outside to make a sleeve for my oversize socket.

Two days later, I was back at my lathe eagerly

trying out my purchase to see how much it would have to be turned down to make it fit. After much measurement and curiously varying results I decided it would be safer to make a wooden plug-gauge to fit into the mandrel. This I did in the rough, and as it was soft wood, I "lapped" it into the socket, using plenty of oil. When I was satisfied that my plug-gauge was a reasonable fit, I used it as a gauge for turning my tapered sleeve, and found that the latter would require to be reduced to a mere shell of twelve thousandths thick. The adaptor, as supplied, had a plug in the end which was nicely centred, and the tang-end of the adaptor was sufficiently thin to make contact with my live centre hidden in its cavity; so, clamping a carrier as near the mandrel nose as possible, I set-to to make the sleeve. First, I measured off 2 in. from the open end of the adaptor, and turned a deep groove to within a few thousandths of what was to be the finished size. My only micrometer would not fit into the groove, so I put two short lengths of $\frac{3}{8}$ -in. silver-steel into the groove and measured over the outside of them. Next, I turned off a $\frac{1}{4}$ -in. parallel band at the mouth of the adaptor, and this I took down to within two thousandths of the finished size. Then I got busy with the long and monotonous job of turning down the main body; but a good sharp tool, newly ground and finished on an oil stone, took off a surprisingly heavy cut, and soon the air was heavy with the familiar odour of hot turpentine and tobacco smoke. I use old engine oil mixed with turpentine as a cutting oil for steel, and find it extremely effective.

The Final Cut

Much stopping of the lathe for measurement (how I blessed the sewing machine clutch on my countershaft), and at last the final cut was accomplished, and the tool marks removed with a strip of well-worn and oil-laden emery cloth, applied on an inch broad lath of wood. One last measurement with the micrometer at each end of my completed sleeve, and with my heart in my mouth I removed it from between centres and sawed off the unwanted end, finishing it off with a smooth file. Then knocking out the live centre from the mandrel I inserted the shell-like result of my labours, and gave it a tentative twist and shake to see how it fitted. It was a good, firm fit, though the end projected about $\frac{1}{16}$ in. from the mandrel; so to make sure of perfect contact, I lapped the sleeve into its bed with a smear of fine carborundum paste, and then washed it and the bore clean with paraffin, followed by petrol.

To press the sleeve into place I used the tail-stock, driving it home with a quick turn of the hand-wheel, and there it has stayed ever since, firm and true.

Converting a Dynamotor

by H. J. Perraton

IN view of the many ex-service appliances on the market at present, perhaps the following article on the conversion of one of these would be of interest to readers.

It is a good idea to have in the workshop a 24-volt D.C. supply, as many ex-government appliances and motors of this voltage are now

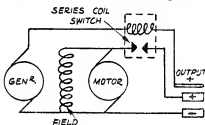


Fig. 1

available, from $\frac{1}{8}$ h.p. to 5 h.p., intermittent rating.

There are many ways of obtaining a 24-volt supply. One quite good method is to have a suitable transformer and rectifier, or again, if large currents are required, a large-capacity storage battery or accumulator of the 100-200 amp. hr. type. I might add here that in this connection it is a very great advantage to obtain if possible the "Nife" alkaline cells, as these are practically indestructible (provided no acid is used in place of caustic soda), and can be "dead shorted" without fear; in fact this treatment actually improves the performance.

In my own case, I use two large batteries of the "bus" type. These are each 12 volts, and are connected in series to give me 24 volts. For conduit, I use car-starter cable, which will carry many hundred amperes, and provides all my needs for the heaviest work. These batteries are charged from a 1½-kVA transformer, feeding two large Westinghouse metal rectifiers, giving full-wave rectification and a quite useful current of 15 amp., sufficient to charge up these accumulators in a few hours.

Of the many ex-R.A.F. electrical appliances, available from many sources, is a rotary transformer called a "Dynamotor," sometimes also called in the service "voltage boosters." It is a beautiful instrument made by Messrs. Rotax, the famous manufacturers of car electrical equipment. It follows typical rotary transformer practice, with common-field coil and double-ended armature; the input, or motor-side having a four-brush commutator, and the output-side having a two-brush commutator, with brushes set at 45 deg.

Many model engineers may be in possession of this type of machine, and have been at a complete loss to find a suitable application for

it. I have found these machines to be capable of quite efficient welding, either by the carbon arc, or the metallic arc variety. They must, however, be modified slightly if they are to be of use to us as welders.

Start by completely stripping the machine. This is quite simple and straightforward to anybody with the smallest amount of mechanical knowledge, and needs no special description here. During the process, examine all parts for wear and general cleanliness, re-grease the ball races before reassembling, as the original will be found to be full of H.M.P. grease in a semi-solid state.

In one end of the machine, which is provided with a special deep housing case, will be noticed a curious relay affair. This is the "series-coil switch," simply a series-relay switch, the solenoid of actuating coil of which is in series with the output terminal; that is, the smallest of the three pins in the connector block. The other two heavy-gauge pins are the input to the motor side, and are made heavy to carry the large current which this takes (in the region of 200

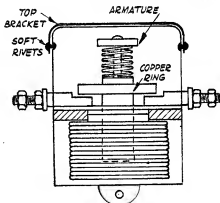


Fig. 2

amp.). Now, most of us will appreciate that to switch on and off a large current such as 200 amp., calls for something in the nature of a pretty substantial relay; so one cannot do better than use the series coil switch provided by the makers. This is the part that needs the alteration. The machine could be used as it is, but as the solenoid of the relay is in series with the output, every time the circuit is broken, such as interruptions in the continuity of a weld, it means a stopped motor, and this coil switch requires at least 20 amp. to keep it "in"; so this is clearly unsatisfactory.

For the sake of clarity a diagram of the original circuit is shown in Fig. 1.

Perhaps a preliminary run is advisable in

order to get some idea of the machine's behaviour. Connect your 24-volt supply to the two largest pins in the connector block through the heaviest cable obtainable (car-starter gauge), by means of two closely-fitting sleeves. These can be easily made in the lathe from either brass or "dural" rod. If "dural" is used, of course no soldering is possible, but this difficulty can be got over by small clamping screws, by which the cable ends can be attached to one end of the sleeves. These sleeves should be turned a nice, close push-fit on the pins. By the same method, attach another length of cable to the small output pin, this need not be as heavy as the first, 12-s.w.g. braided copper will do very nicely. Make this last piece about 2 ft. long for convenience.

Obtain a moving-coil D.C. voltmeter, maximum reading anything over 25 volts up to 50 volts. Connect the negative lead of this to the battery negative, and the positive lead to the output lead from the dynamotor. Should no reading appear, everything is in order; but if a reading is indicated, the connections to the dynamotor from the battery must be changed

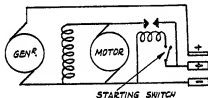


Fig. 3

over. This ensures that the positive is in the correct line. Now take the lead from the output pin and connect to a suitable load resistance, such as a 10-ohm. coil of resistance-wire, or a large projector lamp of 80 volts, or even another 24-volt motor (for that is the load for which this machine is used on an aircraft), and take the other lead from this and connect with battery positive. Provided this last-mentioned load takes a current of 15-20 amp., the dynamotor will immediately spring into life, the secondary voltage rising to about 80 or thereabout, depending on the amount of current taken by the load. The total wattage that can be taken from the secondary is 2,000; quite considerable, and more so when one considers the size of the apparatus.

On removing the output lead from the battery positive, however, the machine immediately ceases to function, so the difficulties of welding with this state of affairs becomes obvious.

To convert the series-coil switch to continuous operation, it will be necessary to remove it completely from the frame, noting very carefully meanwhile exactly how the various connections are made, and how the use is made of the insulating washers.

Having done this, it will be noticed that the main supply to the motor through the heavy conductors is interrupted by the points in the relay, this contact is completed by the copper ring attached to the steel armature of the relay,

which is held in the off position by a spring in its base, and is retained by the bracket on the top, this bracket being held in position by four soft rivets (Fig. 2).

Remove these rivets, and the top bracket will come away. The armature can now be withdrawn; be careful not to lose the spring in its base. Now unscrew and withdraw the main contact terminals; the other bracket covering the solenoid can now be removed. To remove the solenoid coil itself, a small centre-punched screw will be observed at the base of the tunnel in the coil; file off the bottom of this, and the screw can now be removed easily. Having done this, strip all the wire off the solenoid coil, which will be found to be of heavy gauge, about 14-s.w.g. and rewind it with about 30-s.w.g. enamelled copper, filling the coil completely. The instrument can now be reassembled, being careful to replace everything as before. One thing is different, however. The series-coil now has a much higher resistance than before, and is not connected in series with the output, but is connected in parallel with the input. To do this, bring the coil ends out to the small terminal block as before; connect one end to the end of one of the large pins in the connecting block, and the other to the other pin in the same block. We shall want some means of being able to switch this on or off; so break one of the leads to the coil, and insert a small panel switch (any radio panel-type will do fine), this switch can be countersunk into the end panel cover, and will leave a nice, clean appearance. The modified wiring diagram is shown in Fig. 3.

You will now be left with one lead unaccounted for, and that is the output lead from the generator side, which will be observed coming through the hole in the upper portion of the housing. Take this lead direct to the small pin in the connector block. Your machine is now ready for use, and the end-cover can be replaced.

I must mention in passing that there are two models of this dynamotor on the market, one with a secondary rating of 80 volts and another with a rating of 50 volts; but either will answer satisfactorily.

It cannot be overstressed that these machines are not suitable for continuous operation, as their use on aircraft was confined to periods of a few seconds; but they will not overheat unduly if run for short periods of 3 to 4 min., in which time most small welding jobs can be completed.

To complete the outfit, I made a small welding-rod holder from ½-in. copper rod, covered with perspex tubing as an insulated handle; this rod is connected to the lead from the secondary output, i.e. from the smallest pin, and the return circuit is provided by a lead which is taken from the main battery negative, terminating in a large spring clip. The current provided by this machine is, of course, D.C., and is quite suitable for most amateur tasks.

In conclusion, I might add that the cost of the whole outfit was but a mere 25s., plus the small amount of time required for the alteration, and it is quite efficient in operation with 16-gauge welding rods. My own machine has also a nice, pleasing black-crackle finish, and looks quite high-class, which indeed it is.

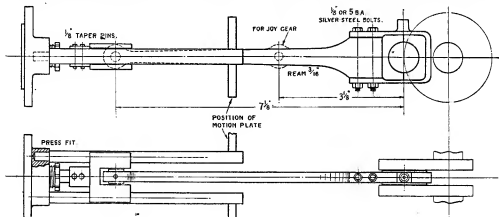
Motion Details for "Maid of Kent"

by "L.B.S.C."

THE full-sized Ashford L1 class engines have four guide-bars per cylinder, and crossheads having separate slippers; but as the "Maid" is intended both for easy construction and hard work, I am substituting a simpler arrangement which is not only easier to make and erect, but gives a more sturdy form of construction for the small size of locomotive. My Webb compound, "Jeanie Deans" has the same kind

with the piece running between centres. Our old late and lamented friend Mr. "Iron-wire" Alexander was a great advocate of turning parts between centres—even cylinder covers—but with the type of lathe in common use at the time he wrote his book, he had jolly good reasons for his advice!

A groove, $\frac{3}{8}$ in. wide and $\frac{1}{4}$ in. deep, is next milled in the middle of each narrower side.



How the parts are erected

of guide-bars and crosshead for her inside low-pressure cylinder, and they have given every satisfaction in service. Briefly, it is the usual arrangement of top-and-bottom rectangular bars and alligator crosshead, "laid flat" in a manner of speaking, the bars being erected side by side, and the crosshead slotted across to accommodate the little-end, the crosshead wrist-pin floating instead of being screwed in. The guide-bars are simply four $5\frac{1}{2}$ -in. lengths of $\frac{1}{2}$ -in. by $\frac{3}{8}$ -in. mild- or silver-steel. Chuck each truly in the four-jaw, and turn down $\frac{3}{8}$ in. length to a full $7/32$ in. diameter, a tight fit for the holes drilled in the gland bosses on the cylinders. Press them in, making sure they are square and parallel, and that is all there is to it until the motion-plate is fitted.

Crossheads

The crossheads can be made either from steel, or good hard bronze. Maybe our advertisers will supply castings; but if made from the solid, a piece of $\frac{3}{8}$ -in. by $1\frac{1}{2}$ -in. bar about $3\frac{1}{2}$ in. long, will be needed. Turn the bosses first; to do this, the piece may be chucked in the four-jaw, set to run truly, faced off, and the end turned down to $\frac{1}{2}$ in. diameter for $\frac{1}{2}$ in. length. Reverse in chuck, and repeat operation. On a small lathe, it would be better to square off both ends roughly with a file, centre them, and turn the bosses

This can be done in exactly the same way as described for axleboxes, either traversing it across a $\frac{3}{8}$ -in. end-mill, or slot-drill, in the three-jaw, the piece being clamped under the slide-rest tool-holder; or holding in a machine-vice (regular or improvised, as previously described) on the saddle, and running it underneath a cutter mounted on an arbor between centres. Then either saw the piece in two, or put it in the four-jaw and part off; if the latter, watch your step as you feed the tool into the cut, otherwise there will be a crack, and maybe a hole in the workshop window, or casual damage to some part of your own anatomy. If sawn, chuck in the four-jaw anyway, and face off the saw-marks, cutting back to leave the rectangular part of the crosshead 1 in. long.

The next job is to drill and ream the hole for the wrist-pin, which is located on the centre-line of the groove at $\frac{3}{8}$ in. from the leading end. Mark off carefully, put a $\frac{1}{8}$ -in. pilot-hole through first, using either drilling-machine or lathe to ensure the drill going through exactly at right-angles to the sides. Open out with $\frac{1}{2}$ -in. drive-fit size (letter D, if you have it) and ream $\frac{1}{2}$ in., so that it will take a wrist-pin made from $\frac{1}{2}$ -in. round silver-steel, without any slackness. Finally, cut the opening for the little end of the connecting-rod; this is $\frac{3}{8}$ in. wide and $\frac{1}{2}$ in. deep, and can be cut by the method described for milling

axleboxes, or clamped under the slide-rest tool-holder, and fed on to an ordinary end-and-face milling-cutter, $\frac{3}{8}$ in. wide, mounted on an arbor between centres. If no suitable cutter is available, careful hand work with saw and file can do the trick very well.

In case beginners have made any slight errors in drilling the holes for the guide-bar spigots in the gland bosses on the cylinder covers, thus throwing the bars slightly out of their correct position, locate the holes for the piston-rods in the crosshead bosses by a method that is as old as the hills, but exceedingly effective. Take off the cylinder cover, with guide-bars attached, and put the crosshead between the bars, running it up hard against the gland, and clamping it there temporarily. Next, holding the whole issue in a machine-vice, either on the drilling-machine table, or held against a drilling pad in the lathe tailstock barrel, make a deep countersink on the crosshead boss, putting the $\frac{1}{8}$ -in. drill through the piston-rod hole in the cylinder cover, and the gland. This countersink will then of necessity be dead in line with the piston-rod, seeing that the latter works through the holes that guided the drill. Remove the crosshead, drill a $\frac{1}{8}$ -in. pilot-hole through the countersink, follow up with the letter N, or 19/64-in. drill, then broach the hole with a $\frac{1}{8}$ -in. parallel reamer until you can enter the piston-rod into the boss for about half the length of the latter, by hand. In full size, the end of the piston-rod is tapered, and fits a taper hole; but, in the small engine, it will suffice if the crosshead is gently driven on to the rod, the latter method also providing for adjustment to get the same clearance between piston and cover at each end of the cylinder. Don't, however, drive the crossheads on yet, for reasons which you'll presently see.

Note: the above guide-bars and crossheads are suitable for the "Maid of Kent" only. For reasons already explained, the "Minx" will have guide-bars and crossheads similar to "Petrolia."

Connecting-rods

The connecting-rod shown is a simplified edition of full-size practice. If link-motion is fitted, the centre part of the rod is just a plain taper; if you are using Joy gear, it will need a bulge, with a hole for the jack-link pin, at 4-in. from the little-end, as shown by dotted lines in the illustration of the assembly. For the main part of each rod you will need a piece of 1-in. by $\frac{1}{2}$ -in. mild-steel bar 7-in. long (a bit longer if you are going to use the Averill wheeze of turning it to outline between centres) and this is marked out, drilled, and shaped to the given outline, exactly as described for coupling-rods, so we need not go over all that part of the ritual again. The little-end is drilled $\frac{1}{8}$ in. and fitted with a bronze bush which projects $\frac{1}{8}$ in. at each side, keeps the little-end central in the crosshead jaw, and provides additional bearing surface at a point where it is urgently needed. Drill an oil-hole in it; or if you are a relation of Inspector Meticulous, fit a little oil-cup. I fitted oil-cups to the little-ends on my $\frac{3}{8}$ -in. gauge "Grosvenor," not because I am any relation to the old

"worrier," bless his heart, but because I was so used to seeing them on the big engines, that I missed them badly. Besides, if I don't have any places in which to poke the spout of my oil feeder, it won't be like old times at all! Builders who intend to use Joy gear can either have a plain reamed hole in the rod, or put a bronze bush in it, in which case the bush need not be more than $\frac{1}{8}$ in. diameter. There isn't an extraordinary amount of wear, the gear being easy to drive, and you don't want to weaken the rod unduly by drilling a huge hole through it.

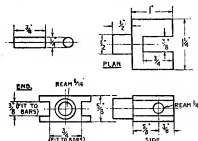
Reference to Inspector Meticulous reminds me that that worthy would probably specify the big-end strap to be cut from a solid slab of steel 2 in. long, $1\frac{1}{2}$ in. wide, and $\frac{1}{2}$ in. thick; but you needn't go to any such trouble. "Jeanie Deans" has a similar inside big-end, and all I did was to get a bit of strip steel and bend it to shape. It will be quite O.K. if you do the same. You'll probably have a short end left over from the bar from which you made the connecting-rods; well, just round off the corners at one end, and use it as a jig over which you can bend a piece of $\frac{1}{8}$ -in. by $\frac{1}{2}$ -in. flat rod, to the shape shown. Square off the ends to a length of 2 in. Turn up the oil-cup from a bit of $\frac{1}{8}$ -in. round steel; and when parting-off, leave a pip on it. Drill a weeny hole in the strap, drive the pip into it, and that will hold the oil-cup to the strap whilst you braze or silver-solder the joint. The oil-cup can then be drilled out and counterbored, $\frac{1}{8}$ in. and $\frac{1}{16}$ in. respectively, and filed off each side flush with the strap.

Now we come to the big-end brasses, which aren't brass at all; funny how the old terms become established, and stick like glue! As they take all the stress when the engine is doing the doings, they need to be pretty substantial. Although not adjustable in the way those of a full-sized engine can be adjusted, by gib and cotter, they can be taken up by filing the butting edges slightly, and fitting a shim in between brass and strap.

The way I make mine is to get two pieces of flat bar, each big enough for one-half the complete bearing, solder them together, edge to edge, and machine up as one unit. In the present instance, you would need two pieces $\frac{1}{2}$ in. wide and a full $1\frac{1}{2}$ in. long; or the nearest size larger, the width being $\frac{3}{4}$ in. Put these side by side, clamp temporarily together, and solder them; then file or mill to the shape of a square measuring $1\frac{1}{2}$ in. each way, rounding off the corners. Stage two, is to mill a groove $\frac{1}{2}$ in. wide and $\frac{1}{8}$ in. deep, top and bottom; you should know how to mill grooves by this time! The groove should just fit the strap. Make a centre dot right in the middle, on the joint line, but don't hit the centre-punch hard enough to split the two halves apart. Grip in the machine-vice by the ends, or use an ordinary tool-makers' clamp over the ends, so that the drilling operation won't "do the splits" either; then drill a $\frac{1}{8}$ -in. pilot-hole, open out by two stages, and finally ream $\frac{1}{2}$ in., taking the sharp arris off the hole, at both sides, with a scraper or similar tool. Try the bearing between the crank webs; if it doesn't fit easily, put it on a stub mandrel in the three-jaw, and take a skim off each side. We used to reckon, on the old "Brighton," that a big-end was O.K. if it could

just be moved the weeniest bit between the crank webs; not enough to cause a knock, but sufficient to make certain there was no chance of it binding.

On the centre-line of the strap, $\frac{3}{16}$ in. from the end, make a centre-pop, and another a bare $\frac{3}{8}$ in. farther along, on both the "prongs." Drill these out with No. 30 drill, and file off any burrs. Now put the brasses in the strap, and put the whole issue in position on the end of the connecting-rod, squeezing it up tight against the butt end.



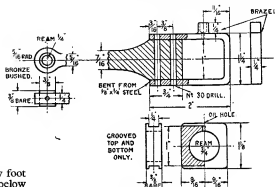
Crosshead details

For this purpose, I use a clamp with a claw foot which goes over the connecting-rod just below the butt. It was made from an old carpenter's cramp, with a notch filed in the foot. Put the No. 30 drill through the holes in the strap, and drill halfway through the butt from each side, so that the holes meet in the middle. If a beginner tried to drill clean through the butt from one side only, it is a million dollars to a pinch of snuff that, by virtue of the usual cussedness of things in this benighted world, the drill would wander off the straight and narrow path, and come out to one side of the bottom of the strap. I've seen too much of it, to expect anything else! After drilling, take off the strap, mark the brasses by a number or dot on each half, so that they can always be replaced same way; then melt them apart, and wipe off any superfluous solder. The bolts are made from two $1\frac{1}{2}$ -in. lengths of $\frac{1}{8}$ -in. round silver-steel, screwed $\frac{1}{8}$ -in. or 5-B.A. at each end, and furnished with ordinary commercial nuts. There should be only enough thread at the upper end to take the nut, and it should be slightly burred over, so that the nut cannot come off. The nuts on the lower ends of the bolts should be fairly tight on the threads, so that there is no chance of them being lost on the road. Spring washers could be used as a "safety-first" precaution; I used them on "Grosvenor's" big-end bolts and eccentric bolts. Some of our advertisers can supply them in very weeny sizes; Reeves of Birmingham, for instance, stocks them right down to 10-B.A.

How To Erect Cylinders

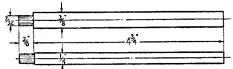
The cylinders can now be temporarily erected in the frames, and all the holes for the fixing-screws drilled and tapped. Erection is a simple job; provided that the frames have been cut to size, and the cylinders machined up to correct dimensions, you can practically do it "by eye," and the only gauge needed is your "stick of inches." The centre of the cylinder casting

on the "Maid of Kent" should be $6\frac{1}{2}$ in. from front edge of frame (back of buffer beam) and as the casting is $3\frac{1}{2}$ in. long, the front edge of the cylinder block—not the cover—should be set exactly $4\frac{1}{2}$ in. behind the buffer beam, at a point level with the centre of the cylinder bore. That settles the longitudinal position. For vertical position, it reckons up just as easy. At the front end of the cylinders, the centre-line of motion is $2\frac{1}{2}$ in. below the top of frame. Now the distance from the centre of the cylinder bores at



Big and little ends

the front end of the cylinders—the bores are, of course, located on the centre-line of motion—to the top of the steam-chest at the cover joint, is also $2\frac{1}{2}$ in., so all you have to do is to set the cylinder assembly so that the steam-chest cover joint is level with the top of frame at the front end of the cylinder casting. To get the angle of inclination, just tilt the whole bag of tricks until the cover joint at the back end is $\frac{1}{16}$ in. below the top edge of frame, leaving $\frac{1}{8}$ in. of the cover itself showing. An easy way of testing, if you are not sure, is to use a length of $\frac{1}{4}$ -in. round silver-steel as a kind of piston-rod extension. This will be true and straight. On one end fit a socket made from any odd scrap of brass or



Guide-bars

steel rod; one end of the socket is drilled a tight fit for the silver-steel, and the other enlarged to fit the piston-rod exactly. If this socket is slipped over the piston-rod, same being fully out of the cylinder, the silver-steel will be in line with the piston-rod; and when the cylinder is set correctly, will pass between the cranks, cutting straight across the centre-line of the axle when same is in running position, $1\frac{1}{2}$ in. from the bottom of frame.

I don't expect that anybody will have a tool-maker's cramp big enough to span over the outside of the frames to prevent the cylinder block

(Continued on page 310)

*FACTORY METHODS

in the Home Workshop

by "H2I"

THE reason for the tool's rigidity lies not in the tool itself but in the lathe mandrel. If this has any slackness in its bearings, it will normally be held down into the bottom of the bearings by its own weight and the pull of the belt; but as soon as a tool is fed into the work in the normal manner from the front, the work continually tries to climb up over the point of the tool, and frequently succeeds. That is the reason for the chatter which makes parting off from the front such a nightmare on a small lathe. With the tool mounted upside-down at the back, however, the tendency is to pull the mandrel down even harder into the bottom of the bearings. It is hoped that the sketch, Fig. 3, will make this clear.

While on the subject of parting-tools, it may be opportune to remark that a number of amateur, and some professional turners make the mistake of running the lathe much too fast when parting-off, particularly in the case of large diameters. The work should revolve far slower for the parting-tool than for any other turning-tool, even when very small diameter bar is being parted off. The writer has succeeded in parting off large diameter tube by pulling the lathe-belt round by hand when all other methods have failed.

Plenty of lubricant is usually an advantage when using the parting-tool, and if a very deep cut is involved the tool should be withdrawn and moved sideways for about half its width and another cut taken, continuing deeper than the first, and then again in the original position, thus relieving the rubbing on one side of the tool.

To obviate the annoying "pip" which is sometimes left on a component after parting off, the front of the tool should be ground at an angle, with the point on the side away from the chuck, so that it completely severs the part while there is still a strong enough pip left on the bar to support it. This is then removed by further advancing the tool. (Fig. 4.)

Allowance should be made for the fact that this "scarfing" of the tool may cause it to spring away from the chuck, giving the parted-off component a slightly concave end. This can be enough to snap the tool, if it is very sharply scarfed and a large diameter is being parted off in hard material.

Chucks and Collets

The average three-jaw chuck is anything but true, as most lathe-users will have discovered, and they will also know that a more accurate method of holding material to be turned is provided by a spring collet, closed either by a draw-tube from the outer end of the mandrel, or by a

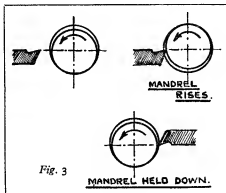
screwed nose-ring on the front. The latter method is regarded with disfavour by some people, owing to its increased overhang; but it has the advantage that there is no draw-tube to restrict the diameter of bar which can be accommodated, as the bore of the collet can be as large as or larger than the bore of the mandrel.

Apart from its accuracy, the collet is very much quicker to operate than a chuck, and in many lathes it can be opened and closed by a lever without even

stopping the machine. Furthermore, special collets can be made to hold bar of hexagonal, square, or practically any other form. In these cases the splits occur at the corners of the form, so that there are three in a collet of hexagonal or triangular form, and four in a square one. Collets for round bar have three splits.

If the amateur, for any reason best known to himself, is unable to fit up his lathe with collets, a good substitute can be found in small split bushes held in the three-jaw chuck. These have been ably described in the past by "L.B.S.C.", but are so useful that it is worth bringing them to the reader's notice again.

Briefly, a piece of round bar is held in the three-jaw chuck, and turned down for a short distance to give it a head. The piece is parted off and held in the three-jaw by the stem part, with the shoulder up against the face of the jaws. With the point of a centre-punch in the corner between the head and the face of No. 1 jaw, a mark is made, half in both. It will be seen that after the bush has been removed from the chuck, it can be replaced in exactly the same position by matching up the marks. The head of the bush is faced off, centred and drilled (and reamed, if possible) the size of the bar to be held. The bush is now removed, and split into the hole from one side only with a fine saw. This cut should be approximately opposite the centre-pop, to make sure it comes in between two jaws. Clean the burrs from the slot inside the hole, and you can now put your bush in the chuck, with the witness-marks lined up, insert your



*Continued from page 257, "M.E.," March 4, 1948.

piece of bar or partly-turned component, tighten up the chuck, and know that no matter how eccentric may be the jaws the job will always run reasonably true, irrespective of the number of times you take it out and put it in again. If the bush is made of silver-steel and hardened, it will last a lifetime.

It frequently happens that some little component has to be turned to shape on the outside, drilled and reamed, and faced on the back. This is an ideal kind of job for these little split

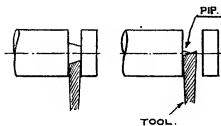


Fig. 4

bushes, and a detailed account of the making of several dozen little phosphor-bronze bushes, with which the writer was recently engaged, will illustrate their use, and also exemplify some of the other points mentioned in this article.

The part referred to is shown in Fig. 5. We were lucky in being able to obtain $9/32$ in. diameter phosphor-bronze rod, which simplified the process of manufacture. A split bush was made to take the $9/32$ in. diameter, exactly as just described. The step was turned with an ordinary tool in the four-tool holder, rigged up in a guide as shown in Fig. 1, the length of turned part being regulated by a toolmaker's clamp for a stop on the lathe bed. This tool was now withdrawn and swung round out of the way, and the hole was drilled just deep enough for two components, not forgetting the two parting-tool widths. The depth of the hole was gauged by means of graduations on the tailstock barrel. If a lathe is not thus marked, this can easily be remedied with a small three-cornered file, making the marks at $\frac{1}{16}$ in. intervals, with the assistance of a rule. The end of the bar in the chuck having been centred with a Slocumb drill (preferably in its own tailstock chuck, to save time in changing), the drill is fed in until the point is just cutting full diameter. The last graduation showing on the tailstock barrel is noted, and the sixteenths counted up as the hole is deepened. For a fairly long hole, it would pay to have a collar to slip over the tailstock barrel, which could be locked with a knurled-head set-screw. (An old brass terminal screw would be ideal.) When starting to gauge the hole depth, the collar would be slid up against the end of the tailstock casting and clamped. The collar now makes a useful check for counting the sixteenths. For some jobs it might be possible to drill only sufficient depth for one component, plus parting-tool width, in case the drill should run out of true and produce an eccentric hole in the second

component. Again, perhaps three or more components could be drilled at a time. This depends, of course, on the length of the job compared with the size of the drill, and the degree of concentricity required. Perhaps this is a bad expression—let us amend it to "limit of eccentricity."

With the saddle up against the stop on the bed, the parting-tool was set up on the back of the cross-slide in the right position for parting off the job to the correct length plus a little bit for facing the back end later. After parting off, and turning the second component and parting off again, a plain facing-tool, the next in the four-way turret, was brought round and the mark left by the drill-point faced off the end of the bar, in case this mark should be eccentric and influence the drilling of the next two components.

To sum up the job, as an operation layout, we have the following:

- Operation 1. Face end; 2. Turn $\frac{1}{4}$ in. dia.; 3. Centre; 4. Drill for two components; 5. Chamfer and remove burr; 6. Part off first component; 7. Turn $\frac{1}{4}$ in. dia. on second component; 8. Chamfer and remove burr; 9. Part off second component.

It should be explained that the usual practice is to provide a stop against which the end of the bar of material is located while the collet is being tightened. This is carried by the tailstock turret along with the drill and centre-drill, but as we are assuming we have no tailstock turret we have to dispense with the stop. Our facing-tool serves the same purpose, in conjunction with the stop clamped to the lathe bed. When tightening our collet or chuck, we make sure that we have enough bar sticking out to enable us to face off the end until it is flat before the saddle comes into contact with the stop on the bed. When we get to this position we know that, if we have set up our other tools right, we can go ahead with our other operations without any measuring, using the stop only, and all the components as we part them off will be reasonably alike.

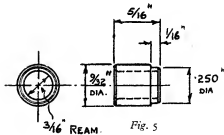


Fig. 5

Notice that we do not ream the job at this first operation. The reader will know that a reamer has a certain amount of "lead" or taper on the end, and it is necessary to get past this before it starts cutting the full diameter. It would thus be necessary, in order to get the reamer cutting properly in the blind hole in the end of our bar, to drill this hole extra deep, which would mean that we would have all this unwanted hole to turn away each time we re-centred. By leaving the reaming until after parting off, we give our-

selves a straight-through hole into which we can poke the reamer as far as we like, to make sure that we have got well on to the parallel part.

We now have a box of half-finished parts, and we must set about facing the backs of them, and reaming and bell-mouthing the hole. We must devise some method to ensure that we face the correct amount off the back of each component, so that they all finish up the same length. There are two methods of doing this. One is to use our existing collet and push the partly-finished component into it by means of a stop in the tailstock. This is not too good, as we are relying on the parted-off length being correct and consistent. A little thought will show that, if there is any variation in the lengths of the components in their present state, the same variation will obtain after finishing, as the same amount will be faced off the back of each one. The writer therefore prefers the second method, which is to make a collet with a step in it, against which the inner end of the component is pushed. Now if the facing tool is controlled by a stop, no matter how much has to be faced off each component, and how much the amount may vary, the components will all finish up the same length.

The reaming is accomplished from the tailstock; but unless a lever-feed tailstock is available, the ordinary screw mandrel will be far too slow for a quick operation like reaming. A more suitable method of operating the reamer, therefore, is to secure it firmly in the tailstock chuck, and then slide the tailstock bodily along the bed and back again, so that the reamer enters the

drilled hole smoothly and evenly, and is withdrawn in the same way. For this to be successful, the drilled hole must be the right size, which is as near as possible to the finished size still leaving enough metal to be removed by the reamer to ensure cleaning out the drill marks. If too much metal is left, in the hole, or, in other words, if too small a drill is used, the reamer will produce its own score marks, or may be so hard to push into the hole that it breaks. For a hole of the size with which we are concerned, the reamer should be made to remove only about two or three "thou" all round.

Having done the reaming, the slight bell-mouth shown on the drawing of the component should be produced by means of a small scraper, placing it in the hole with the cutting edge almost axial, and swinging it round until it is radial. After adding the chamfer with a fine file, the component is removed from the collet and replaced by the next one.

This is the whole story, so far as this particular component is concerned. More complicated components introduce more complicated methods; but, in all cases, the principle is the same—splitting up the operations so that one operation or one small group of operations is performed right through the whole batch of components, rather than making one component complete before starting on the next one. It may mean more handling of the components themselves, picking each up two or three times to perform one small operation each time; but this is nothing to the amount of picking up and altering of equipment which is saved.

"L.B.S.C."

(Continued from page 307)

shifting, but a carpenter's cramp will do it easily; anyway, as long as you can hold the cylinders in position for a couple of minutes, it doesn't matter a bean what method is used. Put your No. 21 (or 19, as the case may be) drill in the hand brace, and make a couple of countersinks at opposite ends of the cylinder on each side, using the holes in the frame as guides. Remove the cylinder, drill out the countersinks with No. 30 drill, using drilling-machine or lathe, and going about $\frac{1}{8}$ in. deep. Tap $5/32$ in. or 3-B.A., replace cylinders and put screws in. These will hold the cylinder assembly in position whilst you run the drill into all the rest of the holes, making more countersinks. Remove the lot once more, and drill and tap the rest of the holes; then replace the cylinders once again, with two or three screws only at each side, and proceed to fit the crossheads to the piston-rods.

Fitting the Crossheads

The crossheads have to be set on the piston-rods in such a position that the clearance between piston and cover is equal at both ends of the stroke; so beginners had better, first of all, check up on their machining and fitting, by seeing how much the full stroke of their pistons exceeds the working stroke. Push piston-rods right home, and mark them where they enter the

glands; pull them right out, and then measure between face of gland and marking. If this distance is $2\frac{1}{2}$ in., the working stroke being $2\frac{1}{2}$ in., it will allow $\frac{1}{4}$ in. clearance at each end, which is quite O.K. Beginners then proceed as follows.

Put the little-end of the connecting-rod in the crosshead fork, and push a $\frac{1}{2}$ -in. bare length of $\frac{1}{4}$ -in. silver-steel through crosshead and little-end bush. Take off big-end strap, enter the crosshead between the guide-bars, then put the brasses over the crankpin and put on the strap, securing with two long bolts. Now push the piston-rod right home, and put the crank on front dead centre, which position is shown in the illustration. If the crosshead refuses gentle persuasion, don't be violent with it, but either ream the hole in the boss a little, or ease the end of the piston-rod. It should go on with a little judicious tapping. When the piston is hard up against the front cover, and the crank right on dead centre, make a mark on the piston-rod $\frac{1}{16}$ in. behind the crosshead boss. Now remove the whole lot; take off the cylinder cover, carefully drive the crosshead farther on to the piston-rod until the mark is level with the boss, drill two $\frac{1}{8}$ -in. holes clean through boss and piston-rod, broach them with an ordinary taper-pin broach, so that they are slightly tapered, and put two commercial $\frac{1}{4}$ -in. taper pins in the holes. Quite easy, isn't it?

Editor's Correspondence

An Old Engine Graveyard

DEAR SIR,—A good deal has been published in THE MODEL ENGINEER regarding old model traction engines. If any reader has the time, he can see a large graveyard of steam plough engines in all sorts of disrepair and rust at the works of Messrs. Bamford and Evenrude, at Saltford Priors, Worcestershire. It lies on the main road between Evesham and Stratford-on-Avon. I have often passed by, but never had the time to call. It might interest some readers to know where these old veterans lie rusting out.

Yours faithfully,
A.Y.

Cheltenham.

Noise Suppression

DEAR SIR,—With reference to the query by Mr. Feasey ("M.E." 12.2.48), concerning the elimination of noise arising from his model engineering activities in a flat.

This is rather an involved subject—and it is not clear from Mr. Feasey's letter—whether the noise he is worried about is air or structure borne, or both.

The suppression of air-borne noise in a flat is hardly practicable—unless he is content to have his workshop heavily damped with sound absorbent blanket. If such a procedure is feasible, the materials are available and the cost should not be excessive.

I am fairly sure however that it is the structure borne noise that Mr. Feasey is meaning.

This is curable by arranging that the source of the noise, i.e. usually a motor, does not have any rigid connection with the building.

All motors, rotating shafts and machinery must have flexible pads interposed between them and the floor, or wall to which they are fixed.

These pads should be arranged so that they are as soft as possible, consistent with stability.

Rubber is the ideal material for this purpose, and mountings are commercially available—employing a block of rubber bonded to steel fixing plates.

It is of course useless to place a piece of rubber or other absorbent underneath the feet of a machine, and then screw through it into the floor.

For bench work it will be necessary to treat the bench legs in the same fashion.

If Mr. Feasey cares to write to me c/o The Editor, I will be pleased to assist him solve this problem.

Yours faithfully,
"ACOUSTICS."

Surrey.

Curved Cranks

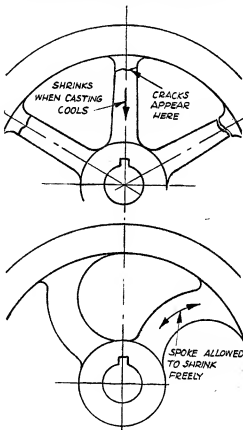
DEAR SIR,—So far I have refrained from entering the correspondence in your columns on the subject of curved spokes in fly-wheels, expecting each week that someone would surely supply the answer.

Many and fantastic have been the theories

put forward, and most of them credit our forebears with very little knowledge of mechanics.

Personally, I thought it was common knowledge that the spokes of cast wheels are curved to allow some measure of "spring" and relieve stresses set up by shrinkage of the metal on cooling.

If the spokes were cast straight, they would try to shrink as they cooled, lengthwise between



rim and hub, and cracks would appear at the ends, as the ends are unable to move.

I have actually seen this happen where an inexperienced pattern-maker has made a wheel with straight spokes. They usually crack where the spoke joins the rim.

Yours faithfully,
Sunbury-on-Thames. GEO. JONES-WALTERS.

[Other letters on the above subject have reached us from readers, but pressure upon our space prevents us using them.—Ed. "M.E."]